COMPUTER-AIDED STATISTICAL INVENTORY RECONCILIATION (SIR) FOR LEAK DETECTION IN UNDERGROUND STORAGE TANK (UST)

by

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16272

Dissertation submitted in partial fulfilment of
the requirements for the
Bachelor of Technology (Hons)
(Information and Communication Technology)

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CERTIFICATION OF APPROVAL

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Business Information System Programme
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Approved by,

_____

(MR. YEW KWANG HOOI)

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

May 2015

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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MAS IDAYU BINTI MOH SALEH

ABSTRACT

‘Computer-Aided Statistical Inventory Reconciliation for Leak Detection in Underground Storage Tank’ is a study undertaken to perform numerical calculation of leak rate for leak detection in underground storage tanks (UST) in petrol station retail business for the enhancement of the current risk assessment and crisis management. The need for this system is for the operator or owner of petrol station to keep track on the leakage of the retail and to ensure the safety measure of the retail by having a computerized system being developed to get statistical record of leakage that might cause hazard in the petrol station. The analysis method applied are literature review and questionnaires to the petrol station managers in order to understand the current business process and management of the retail especially in terms on risk management and health, safety and environment (HSE) issue. The design of the system is drawn and converted into a functional computer system. The development methodology includes the flow diagram to calculate the leak rate of oil in UST. PHP language is chosen for the system because of its transparency and less abstract besides the fact that it can be hosted nearly everywhere. A set of formulas have been developed to calculate on the daily fuel storage as preliminary data to measure leakage. The study concludes that SIR system can be used as preliminary detection method to detect leakage in UST. In the other hand, future enhancement still needs to be done to make it more accurate and reliable.

ACKNOWLEDGEMENT

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1.1 Background of Study

Petrol station retails are exposed to an amount of potential hazards that could lead to danger if not being managed and maintained well. Petrol in definition mainly is a combination of organic substances with variety of physical properties which can lead to many hazards including fire, explosion, health and environmental ("Risk Management Outline to Petrol Operations," 2008). The hazards may cause danger not only to the petrol station, but also to the people, surrounding environment and the reputation of the petrol station itself.

One of the contributing factors of hazards in petrol station retails is the leakage of underground storage tank (UST), a container and any linked underground piping that has at least 10 percent of its joint volume underground. Leakage and spills of petroleum products such as petrol, diesel, kerosene and etc. that are stored in UST can lead to the contamination of the soil, groundwater, surface water and air ("Proposed Protection of the Environment Operations (Underground Petroleum Storage Systems) Regulation 2014 ", 2014).

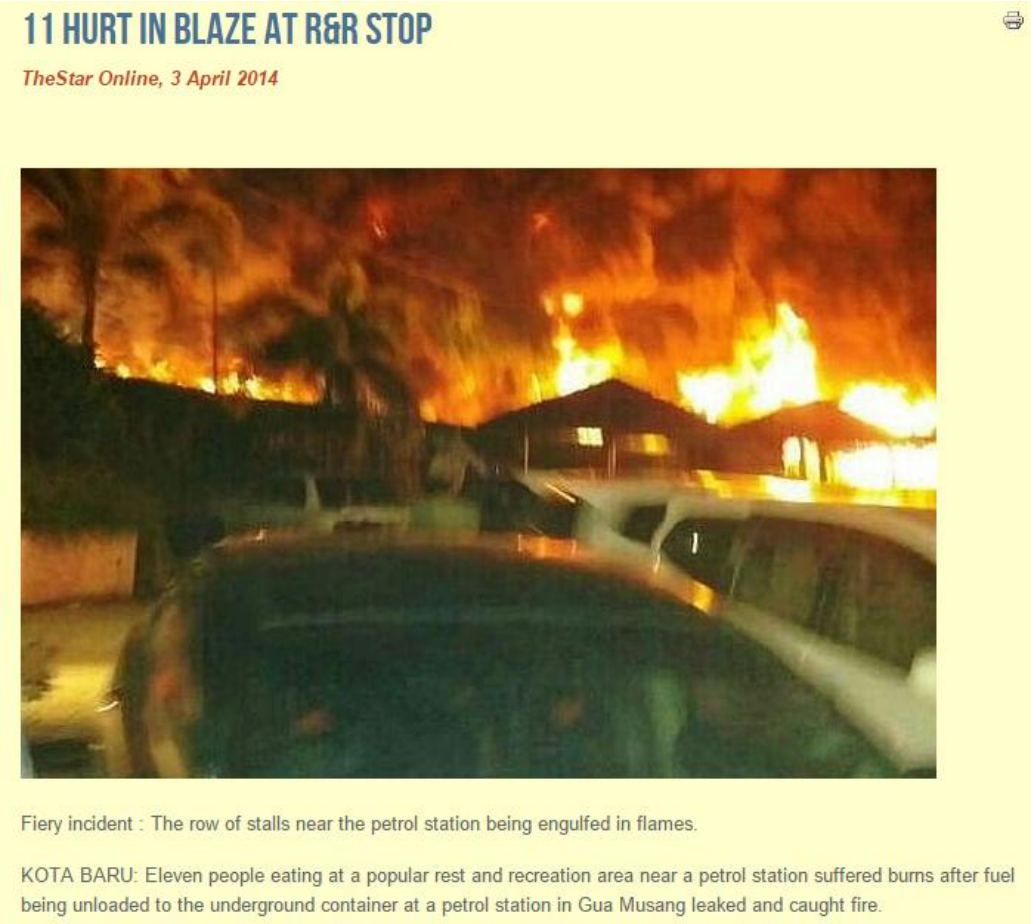
It is burdensome and consume a large amount of cost to actually clean up and treat the contamination in soil and groundwater that caused by leakage and spills of oil in UST. Besides, the polluted soil because of the undetected leakage will consume longer time since it is strictly difficult to clean the consequences it gave. Not only to the owner of the petrol stations, could the leakage also harm the surrounding people and environment. According to a report ("Preventing Leaks and Spills at Service Stations - A Guide for Facilities," 2003), the fuel tanks leakage has as well polluted the water sources for the use of drinking to the nearby communities.

In terms of health, as mentioned by New South Wales (NSW) Environment Protection Authority in their report of Regulatory Impact Statement, listed in the Table 1 below are the components of petroleum and the type of diseases that may cause by it:

Table 1: Type of diseases caused by petroleum components

Component(s) of Petroleum	**Type of disease(s)**
Benzene	Causing cancer in living tissue (carcinogen)
Benzo[a]anthracene & dibenzo[a,h]anthracene	Probable human carcinogens
Fuel mixtures and used oil	Probable human carcinogens
Toluene & Ethyl Benzene	Affecting human's liver
Benzene, Toluene, Ethyl Benzene & Xylenes	Toxicidic to aquatic environment

On 2nd April 2014, a petrol station in Gua Musang, Malaysia caught fire because of the fuel being unloaded to the underground storage leaked. Eleven people were seriously burnt and some foodstalls, four cars and three motorcycles were destroyed because of the tragedy. This incident happened due to the leaked of duel from the hose during transfer of oil (Azhar & Zulkefle, 2014).



11 HURT IN BLAZE AT R&R STOP

TheStar Online, 3 April 2014

Fiery incident : The row of stalls near the petrol station being engulfed in flames.

KOTA BARU: Eleven people eating at a popular rest and recreation area near a petrol station suffered burns after fuel being unloaded to the underground container at a petrol station in Gua Musang leaked and caught fire.

Figure 1: Petrol station in Gua Musang caught fire due to leakage in underground storage tank

Figure 2: One of the injured people, Nur Marisah at Raja Perempuan Zainab II Hospital in Kota Bharu

Risk assessment needs to be done in order for the petrol station owner or manager to limit the amount of potential hazards to the petrol stations that as mentioned above, may give a number of negative effects on many parties including the environment. Some of the efforts of the petrol station retails owner to overcome this issue are by having a good risk assessment and crisis management system to manage the overall operation of petrol station and identify the potential hazards.

There are many assessments included in petrol station's risk assessment. This includes the general requirements, dispenser and underground tank requirements and liquefied petroleum gas requirements (*Dangerous Goods Safety Matters: Self-Check Guide for Petrol Stations*, 2011) . As stated above, one of the main requirements in risk assessment of petrol station is the dispenser and underground tank requirements. The leak control for UST is considered as one of the most crucial risks in petrol station. Poorly installed, improperly maintained and old tanks and pipe work are the main contributors for petrol leakage ("Risk Management Outline to Petrol Operations," 2008). In this matter, the owner of the petrol station is responsible in ensuring that petrol is stored safely. Some actions can be done to reduce the risk of leakage including control measures, control on reliability of storage tanks and continuous management and maintenance.

In controlling the reliability of storage tanks, one of the methods that can be used is by performing the Statistical Inventory Reconciliation (SIR). Petrol stations are required to have leak detection for the UST to reduce the risk of hazards. SIR is one of the available ways where sophisticated computer aided software is used to perform an arithmetic analysis of inventory, delivery and provision data (*Introduction to Statistical Inventory Reconciliation For Underground Storage Tanks*, 1995). All petroleum UST and piping systems installed in petrol stations can use SIR as a tool and initial method in detecting leakage. It is basically done monthly and could result in product piping. Prepared by SIR vendors, petrol stations owner needs to provide these vendors with applicable data for the vendors to analyze it monthly.

1.2 Problem Statement

1.2.1 Problem Identification

In Malaysia currently, it is rather hard to find the statistics and records regarding the issues in health, safety and environment (HSE) of hazards and past records of accidents in petrol stations. Despite the fact that there are not much of accidents being reported regarding safety issues in Malaysia, safety precautions must be taken care seriously by all of petrol stations' owner in Malaysia.

This includes the issues of petroleum leakage of underground storage tanks that could actually give a big impact on surrounding people, environment and reputation of the petrol station retail. Risk assessments currently being done in Malaysia mostly only stressed on the everyday actions of customers and employees in petrol stations. For example, the assessments of hazards focused on the warning of usage of mobile phone during filling of oil and smoking prohibition.

The detection of leakage in UST is whether not being done at all or not being managed and recorded properly by the manager of petrol station retails. Despite the fact that there is a guideline of storage of hazardous chemical in Malaysia, only the precaution of leakage being enforced but the detection of leakage is not put as a lawful act that need to be done by all petrol station retailers in this country ("Guidelines on Storage of Hazardous Chemicals - A Guide for Safe Warehousing of Packaged Hazardous Chemicals," 2005).

1.2.2 Significance of the Project

The project will be a medium for petrol station’s operator as well as the manager as the owner of the petrol station to detect the absence of leakage in underground storage tanks. This project will help in providing a computerized interface to make ease of the work done by the operator. Since the project is a system with graphical user interface which is connected to a database, the data can be stored effectively and can be traced for future review.

1.3 Objectives and Scope of Study

1.3.1 Objectives

The main objectives of this project are to achieve the followings:

1. To study on the current risk assessment for leak detection of UST in petrol station retails in Malaysia.
2. To study on current computerized SIR for leak detection of UST for petrol station retails in developed countries.
3. To develop a system that is able to perform risk assessment on UST using SIR for petrol station in Malaysia.

1.3.2 Scope of Study

The study focuses on how manager of a petrol station retailer in Malaysia manages the risk assessment of the petrol station retail that emphasize mainly on the leak detection of UST using the SIR method. At the moment, the conduct of risk assessments being done are not really emphasizing on the detection of leaks in UST and statistics of cases of leakage of oil in petrol stations are rather hard to be gathered. Some other components in risk assessments such as general requirements and liquefied petroleum gas requirements are not a part of the scope that will be covered in this project.

SIR can be done easily by the person responsible in the petrol station retails which can be used in public domain of the petrol station using computer-based programs. The scope includes the HSE practices in petrol station retails and also the usage of Information and Communication Technology (ICT) and Business Information System (BIS) in petrol retail business. This study can relate the petroleum industry and ICT/BIS industry by using Human Computer Interaction (HCI) and System Design methods.

CHAPTER 2: LITERATURE REVIEW

2.1 Why UST leak detection is important?

As compared to developed countries, the developing countries are less effective in terms of recording of safety measures and statistics (Ahmed, Kutty, Khamidi, Othman, & Shariff, 2012). Ahmed et al. (2012) also discovered that there is a need to control hazards in petrol station retails since the place is full of flammable and hazardous materials. There are indeed a number of contributing factors that lead to hazards in petrol station retails including carelessness, lack of maintenance, falls, transportation hazard and also housekeeping. Besides these factors, another contributing factor that can be seen as a serious factor is the leakage of storage tank.

Figure 3 below is the flowchart showing the potential emissions caused by storage and transfer facilities as referred from the report of Best Available Techniques Guidance Document on Storage and Handling of Petroleum Products by the Department of Environment Malaysia. From this flowchart it can be seen that a list of operational processes such as tank filling, cleaning, draining, purging and etc. could cause the incidents of overfill and leakage.

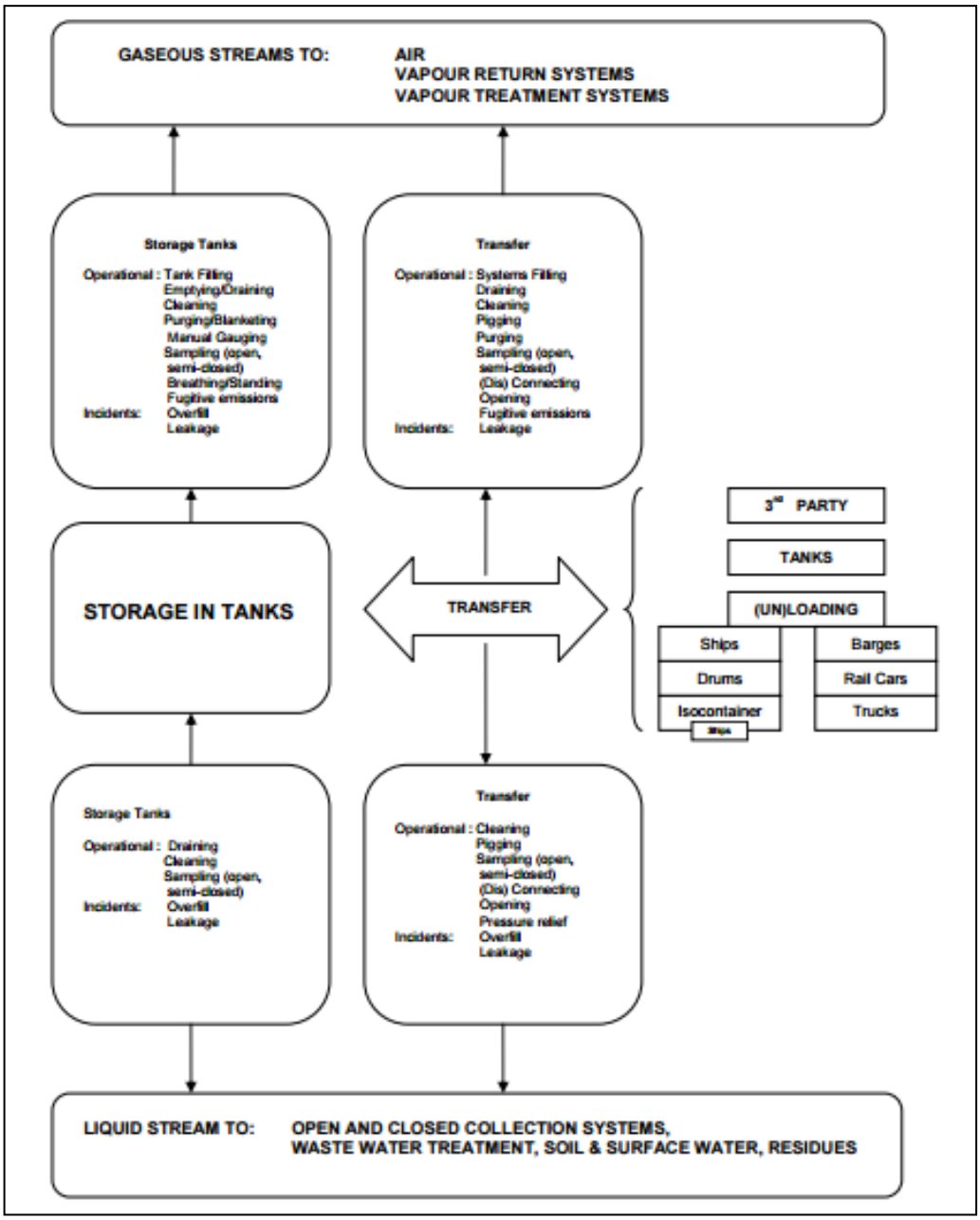


Figure 3: Flowchart of potential emissions caused by storage and transfer facilities

In contrast with above ground storage tank, detection of leaks from UST is a difficult activity since it cannot be observed directly. In a developed country such as the United States, the manager of the petrol station retails with UST is required to follow the federal regulations where they need to have a good corrosion protection, leak detection system, financial guarantee for legal responsibility and spill and overfill protection ("Preventing Leaks and Spills at Service Stations - A Guide for Facilities," 2003). The same law has been mentioned in a booklet by the United States Environmental Protection Agency (USEPA) which mentioned that the

requirement of UST's leak detection has been emphasized in federal and state laws (*Introduction to Statistical Inventory Reconciliation For Underground Storage Tanks*, 1995). Meanwhile in Malaysia, only precautions and practices of housekeeping and spillages are found and no laws and regulations being specifically mentioned for petrol stations' owners to do leak detection.

2.2 What is Statistical Inventory Reconciliation?

According to Department of Environment and Conservation, Division of Underground Storage Tanks (2007), Statistical Inventory Reconciliation (SIR) is computer software being used to perform and make an analytical calculation in daily inventory, delivery and daily pumped fuel collected over the month to examine whether or not there is a leakage in the underground storage tanks (UST). Gauge stick is used to measure the fuel level daily.

Some reports had mentioned that SIR is one of the ways that can be done for petrol station retails' owner to perform leak detection. USAID Armenia in its report mentioned that SIR is an established system that statistically analyzes the losses and gains for each tank in daily basis with considering stock variances and cumulative variances of cumulative sales to identify trends and anomalies (2008).

The USEPA again mentioned that the imprecision of the traditional system inventory control has been the reason of introduction of SIR which can help in reducing the amount of money being loss for losing hundreds of litres of oil per month due to leakage in storage. SIR accuracy helps in analyzing releases of oil from a tank 95% more accurately than the inventory control (1995).

SIR analysis is usually done by the vendors from outside of the company that offers this business to analyse the leakage in the storage tanks. The owner or operator of the petrol stations will submit SIR data as per required by the vendor's company at the starting of each month to do the analysis of leak detection who will then send the results to the owner for record. Alternatively, SIR can also be performed by the operator of the petrol station itself by using stand-alone SIR systems which already trained without assistance of SIR analyst ("Statictistical Inventory Reconciliation

(SIR)," 2007). But in other report, NSW EPA mentioned that this stand-alone SIR system may not have been certified (2014).

SIR analysis can be done quantitatively or qualitatively (SIR, 2007). By using quantitative method, the report must include the calculated leak rates as part of the result while the qualitative method only report the results as "pass" or "fail". Despite of the methods being used, both methods actually would require the vendor to calculate the leak rates but the difference is the presentation of result in the report whether it includes the calculated leak rates value or just the result being captured. As mentioned by the SIR report by State of Tennessee, apart from "pass" and "fail", there is another irregular result in SIR analysis which is "inconclusive" which provide the meaning that "data quality will not provide a conclusive result conforming to the 95% probability of detection (Pd) and no more than 5% probability of false alarm (Pfa) criterion" (2007).

One of the most important criteria in operating SIR analysis is to maintain and keep daily record on the inventory volume accordingly for each of the petroleum products available at the petrol station retail. The operator should not miss any daily record to get the most accurate value of measurement to detect whether leakage in storage is happening or not. The measurement can easily be done by using the dipstick or the gauge stick that can easily be found in any petrol stations with UST where the depth of liquid are measured. Other gauges such as an automatic tank gauges can also be used which will eventually make ease of the operator tasks in measuring the amount of petroleum liquid being stored.

In other Western countries, the leak rates are calculated in gallon per hour (gph). In Malaysia, the measurements of liquids are usually being done in litres. All results of the leak rates, threshold amount and calculated leak rates will be presented in litre per hour (lph). Listed in the Table 2 below is the differences between qualitative and quantitative method while in Table 3 shows the identification of Pass, Fail and Inconclusive result.

Table 2: Differences of Qualitative and Quantitative measures

Qualitative measures	Quantitative measures
• Do not provide estimated leak rates • Report results in Pass, Fail or Inconclusive • Compared with evaluator's knowledge	• Test report in numerical leak rate based on the characteristics of the dataset • Provide numerical estimate rather than just the categorization of result in pass, fail and inconclusive • Calculated in litre per hour (lph)

Table 3: Identification of Pass, Fail and Inconclusive Result

Status	Description
PASS	UST system tests is rigid
FAIL	• Indicate a loss of product from the system • Various factors:- 1. Leakage 2. Evaporation 3. Poorly calibrated dispensers 4. Incorrect metered deliveries 5. Stolen product
INCONCLUSIVE	• Incorrect information • Detection failure

There is a gap in Malaysia's petroleum industries especially in petrol station management and risk assessment where the leak detection system are not being maintained in such a manner that it could be referred to as if any accidents or hazards occur, the potential reasons can easily be identified and managed. Leak detection system in Malaysia mostly covers in the petroleum plants and during transportation

of the oil but not at the petrol station itself where the hazards are more exposed to the environment and surrounding people which are not in precautions if accident, fire or even explosions occur due to leakage of UST. So it is crucial to have daily basis leak detection and monthly basis SIR system for petrol station owner to systematically record the detection of leakage in the UST.

In the following, an example of report produced that indicates whether the leakage occur or not in the month. In this example, the value of P is lower than R so the system will indicate "Pass" as the result. Report is as adopted from ("Daily Inventory and Statistical Inventory Analysis,").

MONTHLY INVENTORY RECONCILIATION REPORT

Month / year February 2010

Facility & Location: Magi Oil, Ft. Kent — DEP Reg # 00000

Tank Size and Fuel Type: 6000 Super NL — Certified by: Tom Smith

Date	A Opening Inventory	B Gallons Delivered	C Gallons Pumped	D Book Inventory Balance	E Closing Stick Inventory	F Daily Over or Short	G Cumulative Over or Short	H Inches Water	I Initials
1	2556		143	2413	2441	28	28	0	TS
2	2441		227	2214	2118	-96	-68	0	ES
3	2118		259	1859	1955	96	28	0	ES
4	1955		225	1730	1733	3	31	0	TS
5	1733		372	1361	1270	-91	-60	0	ES
6	1270	2000	194	3076	3175	99	39	0	ES
7	3175		147	3028	3000	-28	11	0	ES
8	3000		164	2836	2843	7	18	0	TS
9	2843		406	2437	2320	-117	-99	0	TS
10	2320		361	1959	2053	94	-5	0	TS
11	2053		187	1866	1860	-6	-11	0	ES
12	1860		273	1587	1608	21	10	0	ES
13	1608		489	1119	1118	-1	9	0	ES
14	1118		97	1021	1000	-21	-12	0	TS
15	1000		132	868	835	-33	-45	0	TS
16	835		177	658	605	-53	-98	0	ES
17	605	3000	154	3451	3590	139	41	0	ES
18	3590		99	3491	3490	-1	40	0	ES
19	3490		292	3198	3210	12	52	0	TS
20	3210		477	2733	2711	-22	30	1/4"	TS
21	2711		25	2686	2711	25	55	1/4"	TS
22	2711		107	2604	2588	-16	39	1/4"	ES
23	2588		254	2334	2320	-14	25	1/4"	ES
24	2320		303	2017	2085	68	93	1/4"	ES
25	2085	2000	192	3893	3851	-42	51	1/4"	TS
26	3851		284	3567	3544	-23	28	1/4"	TS
27	3544		490	3054	3075	21	49	1/4"	TS
28	3075		166	2909	2898	-11	38	1/4"	TS
29									
30									
Math Check	J	K	L	M		N	O	P	
	2556 + 7000 - 6696 = 2860					2898 - 2860 = 38			

LEAK CHECK: Total Gallons Pumped Q 6696 X .01 = 66.96 R IF THE CUMULATIVE OVER OR SHORT AT THE END OF THE MONTH IS GREATER THAN THE LEAK CHECK RESULT, IT IS EVIDENCE OF A POSSIBLE LEAK AND YOU MUST NOTIFY MAINE DEP WITHIN 24 HOURS AT (207) 287-2651.

Figure 4: Example of report being produced

CHAPTER 3: METHODOLOGY

For any software development, it is essential to plan the project well. Requirement gathering has done before the designing and implementing the software. Different methodologies have been used to cater different needs of the project in the whole duration of time given. Thus, this chapter will mainly elaborate on the:

- Research Methodology
- Project Phases
- Development Methodology
- Tools Used

3.1 Research Methodology

This study adapted a number of research approaches being found in literature reviews mostly from the developed countries or the Westerns for data collection and analysis. The research mainly being done qualitatively by studying the related literature reviews from journals, website articles, online newspaper and books as a tool to gather and compare functional requirements basically from the sources that are related to SIR system that has been developed in other countries. This method helps in finding the solution and strengthens the knowledge about the subject of research. The functional requirements gathered are then be adopted and will be amended to further improve the system and to make it parallel to the requirements of risk assessment of petrol stations in Malaysia.

Besides literature review, a list of questionnaires has been sent to some of the managers of petrol station retails to gather the information on current petrol station management, their risk assessments and how they operate the petrol stations currently with regard to the HSE being implemented. From the questionnaires, it can be summarized that this project is applicable and relevant to be conducted to reduce the risk of hazards that could potentially occur in petrol station retail. The results of the questionnaires are as per attached in APPENDIX 1.

Apart from that, a study of local scene news has also been done to investigate the past cases on leakage of storage tanks occurring in Malaysia. In addition, the non-functional requirements are also being studied to find the external requirements being needed by the system to ensure the accuracy of data and result. Accuracy of the system is very much an important non-functional requirement so that the system will not give inadequate information to the user of the system which later being falsely analyzed. Besides accuracy, the integrity of the operator conducting the operation checking of depth of oil must also be observed to ensure that the daily checking is done without miss.

Figure 5: Research methodology being taken for the project

3.2 Project Phases

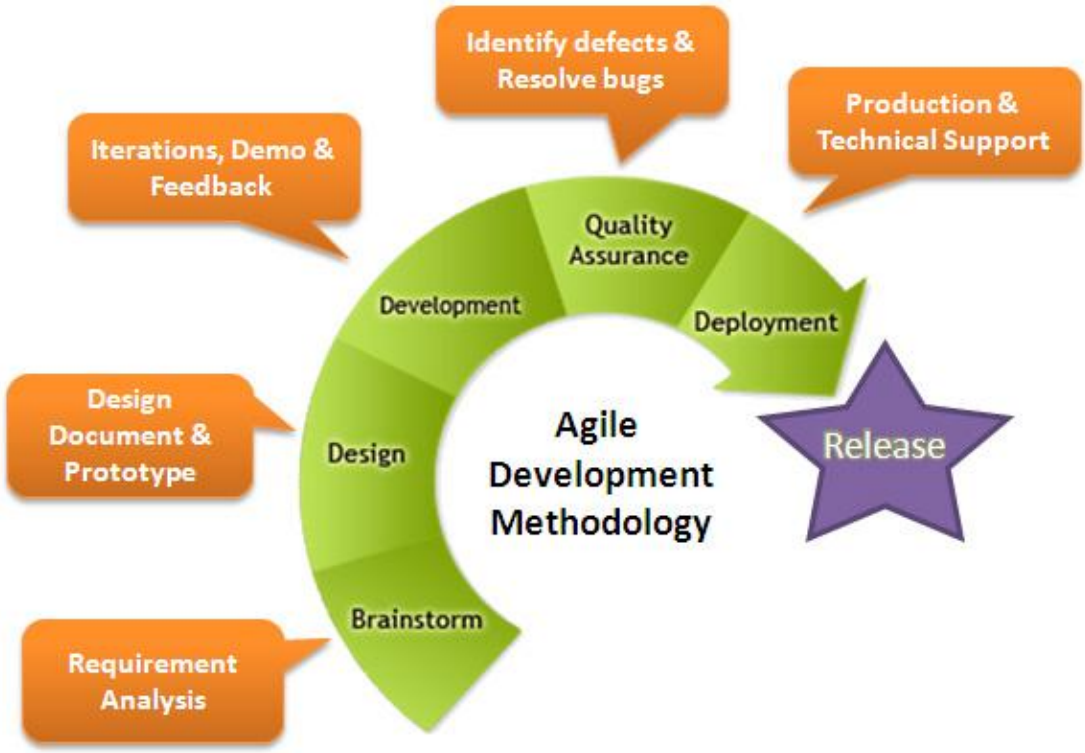


Figure 6: Agile Development Methodology

Figure 4 mainly shows the research methodology being done for the project while Figure 5 shows the agile development methodology being used in the developing the SIR system. The process started with requirement analysis being done at the early stage of the research followed by designing and documenting the prototype. The project is then preceded with development, quality assurance and deployment before it being released.

3.2.1 Planning Phase

For the planning stage, a number of problem statements have been gathered before the project can be developed. Further research and data collection are done at the beginning phase of the project cycle to support the significance and relevancy of the project to be conducted so that the problem statement being stated can be resolved. The planning activities used as the guideline on what need to be done towards the timeline given in completion of the project. To ensure that the tasks involves are correctly assigned, a Gantt

chart is developed as attached in the APPENDIX 2. This is to ensure that enough time is allocated for each task throughout the period given.

3.2.2 Analysis Phase

One of the purposes of data analysis is to uncover the resolution for all the problem statements being identified earlier. Data collection process and research mainly purposed to look for data, information and knowledge in regards to the project title. The analysis phase includes all the activities done in research methodology as been discussed earlier on this paper.

From the analysis, a flow chart has been created as the first draft of how the system flow and how the calculation of SIR can be done. The flow chart were then be altered and adopted in the activity diagram as included in Figure 15 in the next part of this Methodology section. The first draft of flow chart is showed in Figure 6 below.

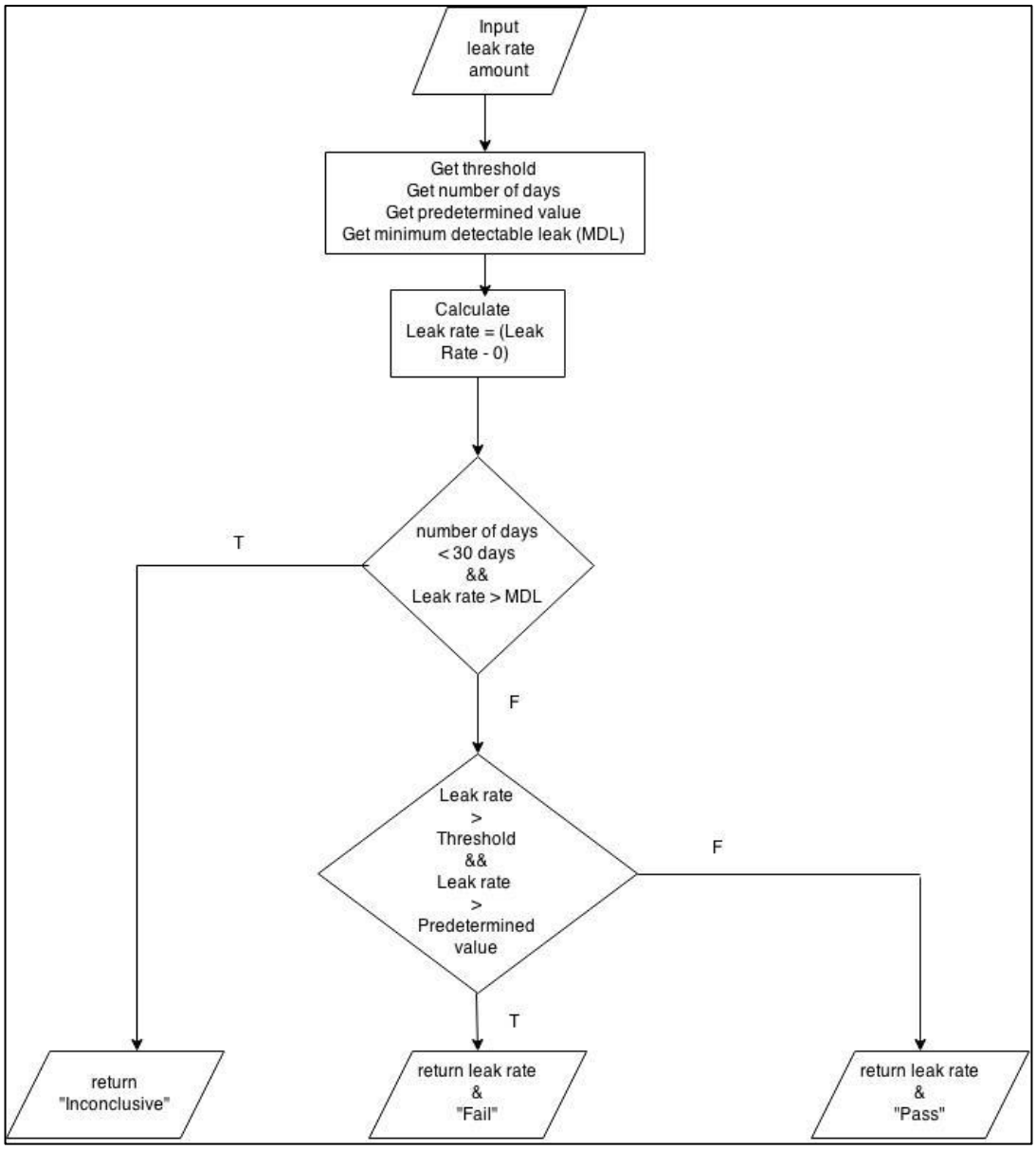


Figure 7: Flow diagram of calculation to determine Pass, Fail or Inconclusive

3.2.3 Design Phase

In the design phase, the real system is developed using the prototyping development methodology. Prototyping model is useful to give the user a proper idea on the software and help to demonstrate the concept of the system to be further enhanced (Sparrow, 2013). Figure 7 below shows the prototyping model that has been used.

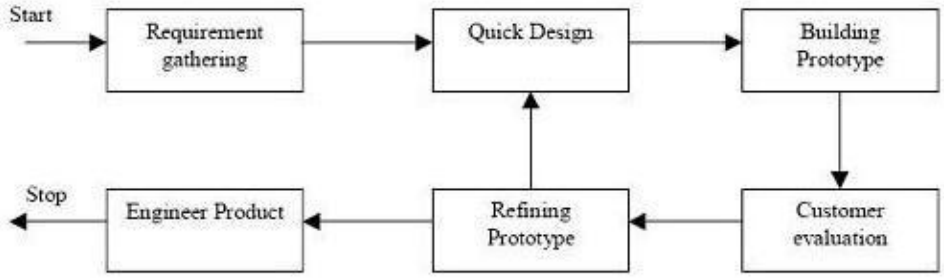


Figure 8: Prototyping model

Graphical user interface (GUI) is seen as one of the way to build the prototype of the system. GUI is important in order to make the interface of the system appears to be more interactive and easier to be used by the user. In this phase, the GUI of existing system has been reviewed as reference and used as guidance to alter it and make it simpler and user friendly. Figures of the existing system is as attached in APPENDIX 4.

3.3 Development Methodology

In order to develop the system, an activity diagram has to be made first to model the way of calculating the leak rates in UST. With that, an algorithm guideline from Tank Smart Module 11 has been taken into account to construct the activity diagram of leak rates calculation ("Daily Inventory and Statistical Inventory Analysis,"). Figure 6 below shows the activity diagram of leak rates calculation.

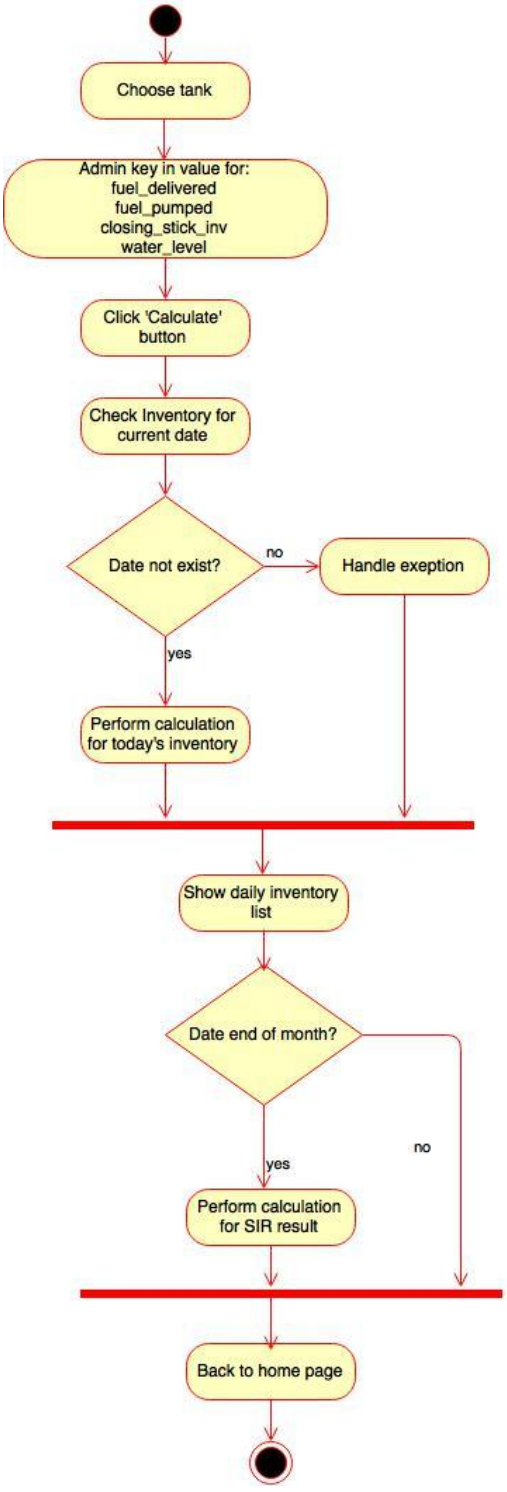


Figure 9: Activity diagram to perform SIR calculation

3.4 Tools Used

The proposed tools required in developing the application are as below Table 4 below:

Table 4: The required software and hardware for development of SIR system

Software	Minimum requirement
Operating system	✓ Windows XP and above
Scripting language	✓ HTML ✓ CSS ✓ PHP
Programming tools	✓ Notepad++
Database tools	✓ PHPMyAdmin
Server	✓ XAMPP ✓ Localhost

CHAPTER 4: RESULTS AND DISCUSSIONS

This chapter discusses on all the results collected from most of the phases in the system development process. The result hopes to support the evidence towards achieving the objectives together with the discussion.

As described earlier, the evaluation of risk assessment has been done by giving out questionnaires to the petrol station manager. As part of the answer of a manager of PETRONAS station in Baling, Kedah stated that "HSE is the most priority issues to the petrol stations" (Amran, 2015). From the findings on literature review and local scene show that the need for risk assessment in petrol station is crucial more importantly for the leak detection of the UST.

From the ICT and BIS point of view, it can be said that a computerized system will help the petrol station retail manager in adapting the usage of SIR system as part of risk management. The statement is proven as stated in a paper UST Technical Bulletin of Missouri Department of Natural Resources that there are a number of advantages of the usage of SIR system in part of risk assessment of petrol station retails. The list of advantages are the minimal number of equipment needed, testing covers both tanks and piping system, precision of the system is rigid and also the monitoring of common operational problems of other equipments can also be done concurrently.

4.1 Analysis

4.1.1 Flow of the System

One of the requirements of the leak detection using SIR is to record and update daily inventory before SIR calculation can be performed at the end of the month. SIR uses web-based computer program to look more closely at the inventory data being stored in the phpMyAdmin database to determine if leak might happen. The report will be generated automatically at the end of the month which will report whether the records pass or fail for the month.

Essential steps of fuel inventory control are as shown in the diagram below:

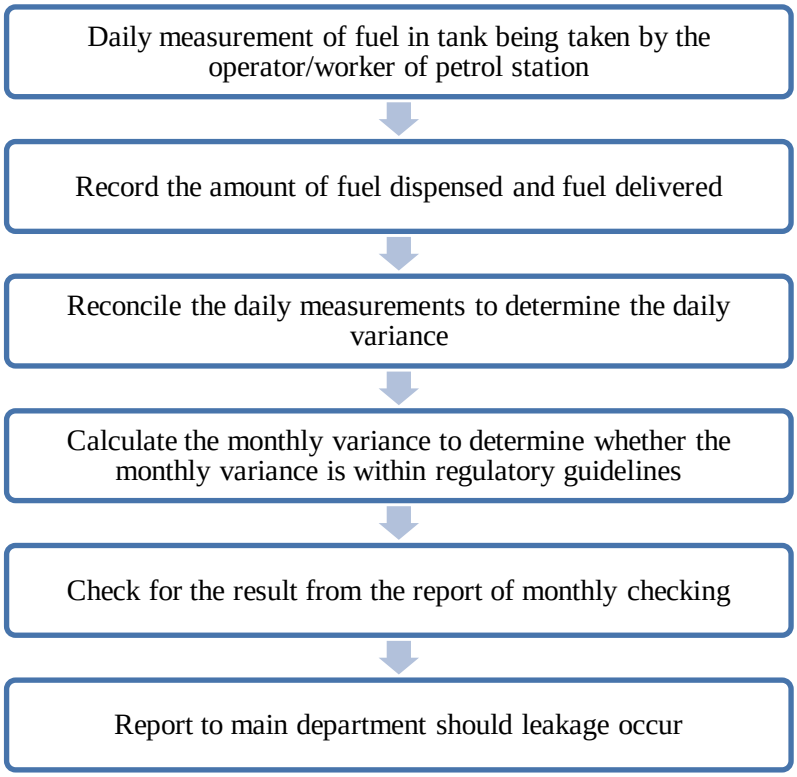


Figure 10: Steps for SIR fuel inventory control

4.1.2 Use Case Diagram Analysis

Use case diagram model the functionalities of the system using actors and use cases. Use case can be described as functions or services provided by an application to the user. The actor of this use case being designed is the operator of the petrol station. The system will allow the user to perform some actions after the user is authenticated in the login page.

The Figure 17 below shows the proposed use case diagram to be used for the SIR system to be created for implementation in Malaysia. The system will analyze the leak detection automatically without the need of vendors to analyze it. The system proposed is the automation of analysis of SIR for petrol station retailers.

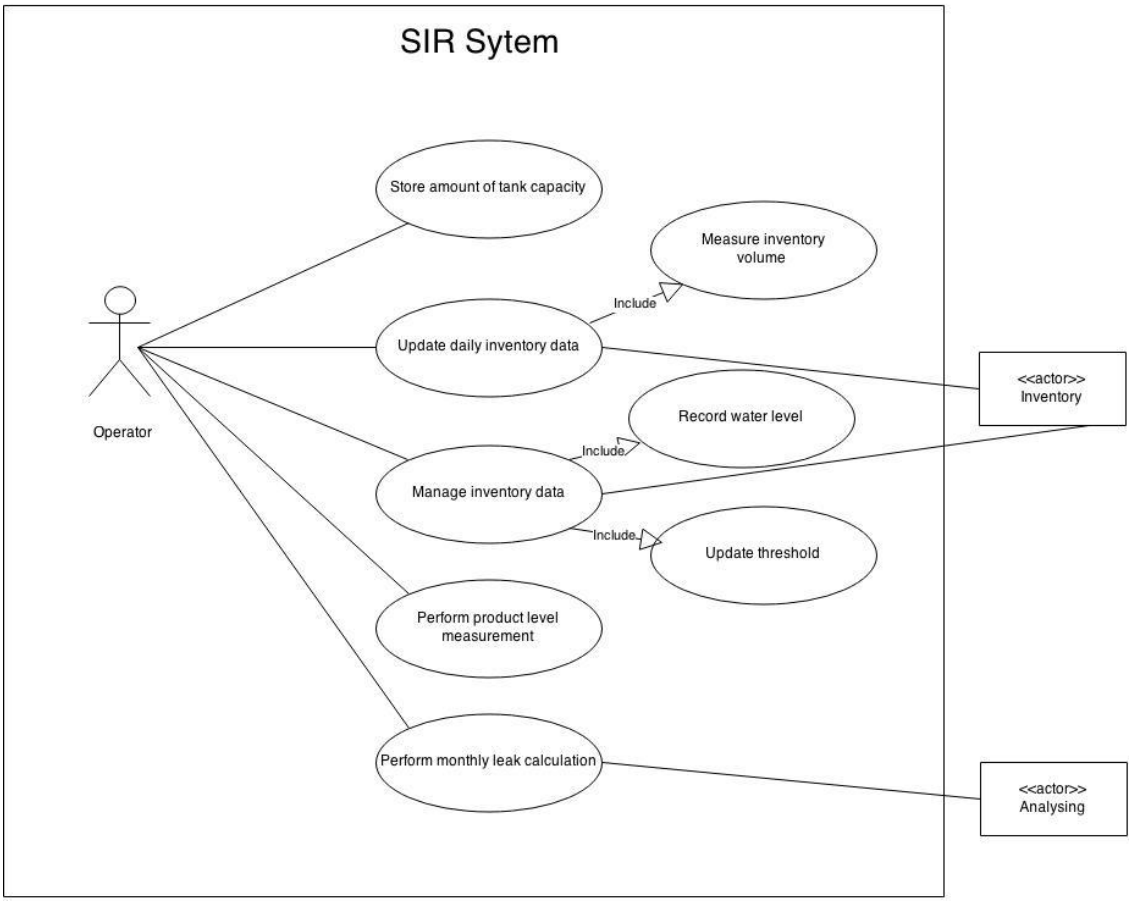


Figure 11: SIR System Use Case Diagram

The system will allow its main user to key in some values such as the fuel delivered, fuel pumped, water level and closing stick inventory. On the other hand, the user will be allowed to process the result of leakage calculation at the end of the month. The daily inventory can also be presented in the system.

4.2 Design

The system will not only implement the contribution of HSE in handling petrol station retail but also HCI elements where human work can be done more easily with the help of technology. Figure below shows the example of the manual system from a technical report of State of Tennessee ("Statictistical Inventory Reconciliation (SIR)," 2007) which will be adapted in making a more sophisticated version of the system with the usage of Graphical User Interface (GUI) that liable to the demand and interest of today's era.

001	SIR Monthly Tank Evaluation Report					Date of Report: 07/11/2008									
FACILITY NAME						ID#:									
TANK LOCATION	Avenue														
	TN					Tel:									
TANK OWNER LOCATION															
	FL					Tel:									
TANK OPERATOR						Tel:									
SIR Provider															
SIR Version	V1.0			<ID:		Site Dir:									
Period Covered	06/08	Fixed Threshold		23 usable days per month required.											
TANK						Current Month							05/08		04/08
Tank ID.	Product	Max. SIR size (gal)	Size (gal)	Leak Thres-hold (gph)	MDL rate (gph)	Calc. Leak rate (gph)	Pass, Fail, or Inconclusive								
							P	F	I	P	F	I	P	F	I
Unlead	REGULAR	45 K	10152	0.100	0.036	0.026	X			X					
Midgrade	MIDGRADE	45 K	10152	0.100	0.015	-0.022	X			X					
Premium	PREMIUM	45 K	10152	0.100	0.031	-0.030	X			X					

Figure 12: Example of SIR Summary Report

The system is built in a simple Graphical User Interface (GUI) using HTML and PHP. The language is chose because of its transparency and it can be hosted from nearly everywhere. From the front-end of the system, user/operator needs to key in values that are collected from daily inventory including amount of fuel delivered, fuel pumped, closing stock inventory, water level and the administrator's initial.

From those values, a set of formula to calculate the monthly leakage has been built as per listed below in the table:

Table 5: List of inventory details

A: Opening Inventory
B: Fuel Delivered
C: Fuel Pumped

D: Book Inventory Balance

E: Closing Stick Inventory

F: Daily Over or Short

G: Cumulative Over or Short

H: Inches Water

I: Initials

J: Opening Inventory of the first day of the month

K: Sum of Fuel Delivered

L: Sum of Fuel Pumped

M: Math Check

N: Closing Stick Inventory of the last day of the month

O: (same as M)

P: Difference between Math Check and Closing Stick Inventory of last day of the month

Q: (same as L)

R: Leak Check Result

The following formulae are used to calculate the SIR value for daily inventory and monthly report (as adapted from ("Daily Inventory and Statistical Inventory Analysis,")):

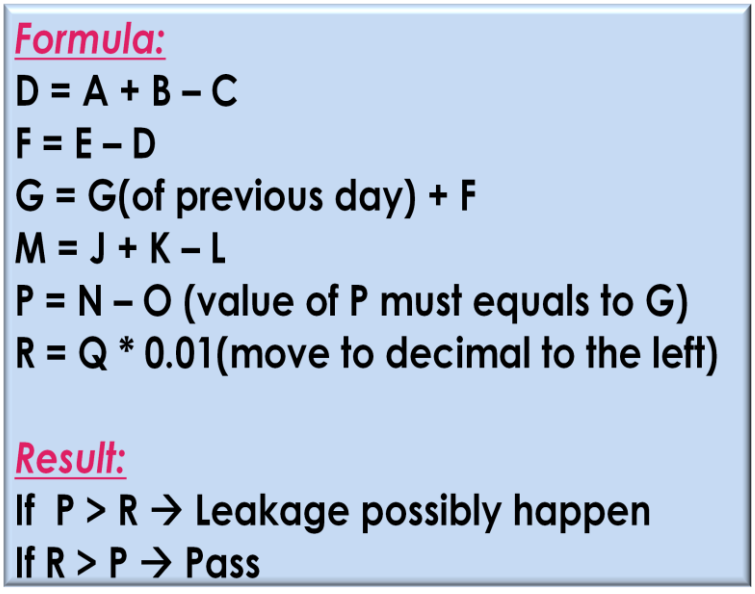


Figure 13: Set of formulae to perform SIR calculation for leak detection

The set of formulae is adapted and converted into PHP language to perform the calculation of leakage. A part of list of formulae is as listed below:

- ***inventory_balance*** = *opening_inventory + fuel_delivered - fuel_pumped*
- ***daily_over_short*** = *closing_stick_inv - inventory_balance*
- ***cum_over_short*** = *prev_over_short + daily_over_short*
- ***math_check*** = *first_inventory + sum_delivered - sum_pumped*
- ***final_cumulative*** = *last_inventory - math_check*
- ***leak_check*** = *sum_pumped * 0.01*

Figure below shows the system architecture being built to show the flow of operation for SIR system:

Figure 14: System Architecture for SIR System

4.2.1 User Interface

A user interface is the part of application which users interact with. The interface usually includes the screen displays that provide navigation through the system, the screens and forms to capture data.

Home page

On the home page, some tabs are available for user access including Home and Login tabs. Tank information details can be seen from the home page. The user needs to proceed to Login page in order for them to key in the

daily inventory details and update any data. Figure below shows the interface of the home page of the system.

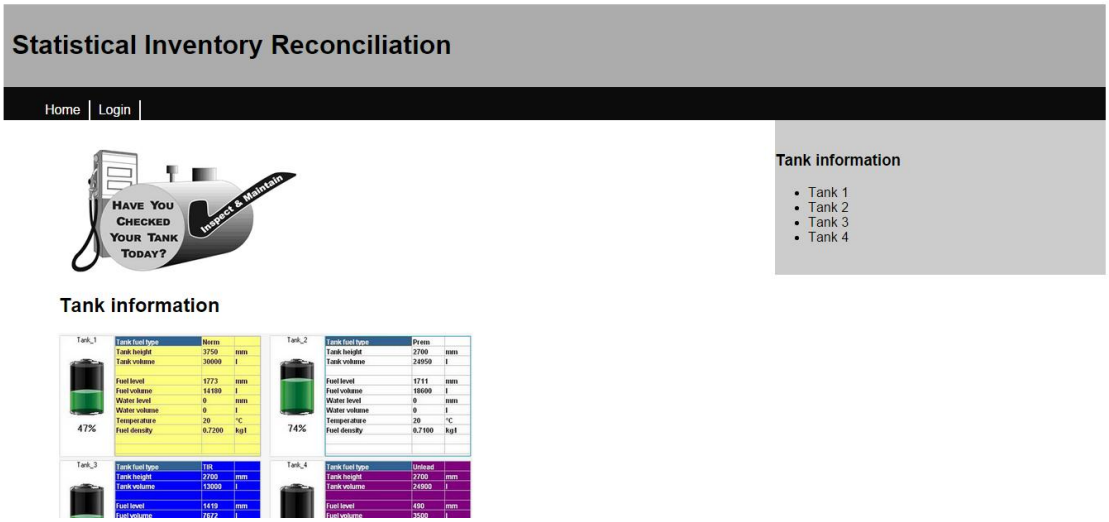


Figure 15: Home page of SIR system before login

Login

When user clicks the Login button from the Home page, user will be redirected to the Login page where user needs to key in the correct username and password in order for them to be authenticated. If the user entered a correct username and password, the page will be redirected to the second Home page of the system which includes new tabs named Services as shown in Figure 22. Else, if the user entered wrong username or password, the system will pop out an error message saying that invalid username or password has been inserted as shown in Figure 23.

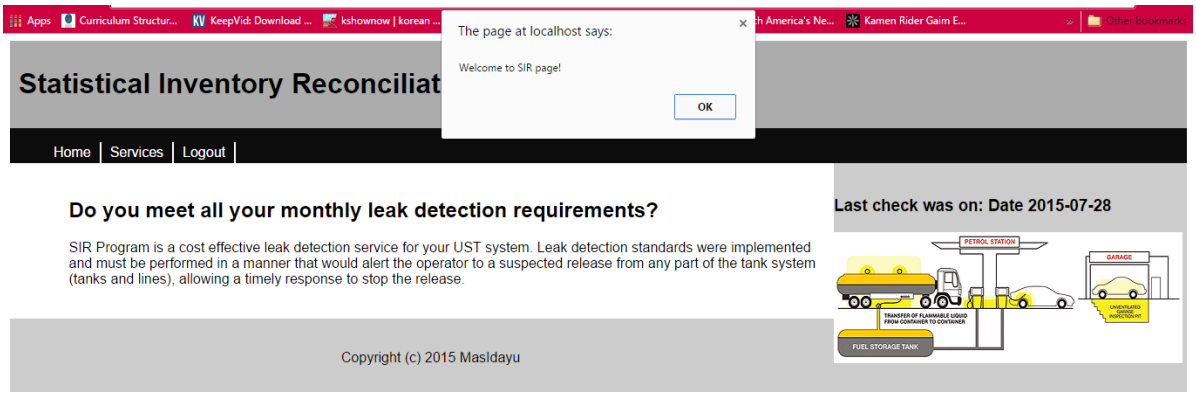


Figure 16: Second home page of SIR system

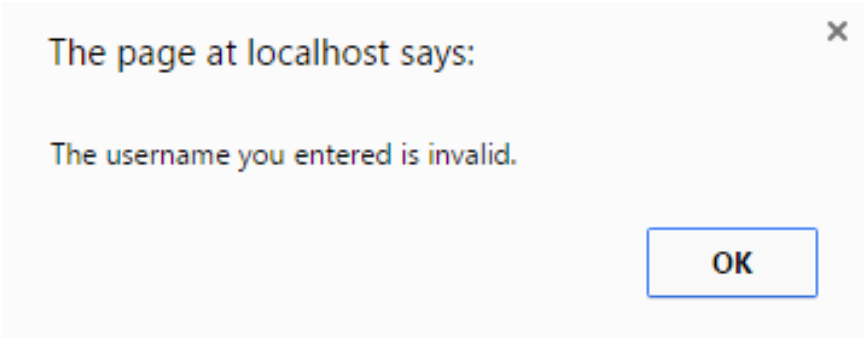


Figure 17: Invalid username entered

Services

The Services page is the crucial part of the system where all the daily inventory details will be input by the user of the system which is the operator itself. The user needs to choose the tank for the date to be input and he/she just needs to key in the data in the boxes provided. By clicking the 'Calculate' button, the SIR system will immediately store the data in the database and check whether it is the end of month or not. For the case where the date is the end of month, the system will automatically display the result of the UST leakage whether "PASS" of "FAIL". Else, the system will just input the data in database and perform daily calculation. Figures below show some part of the Services functionalities.

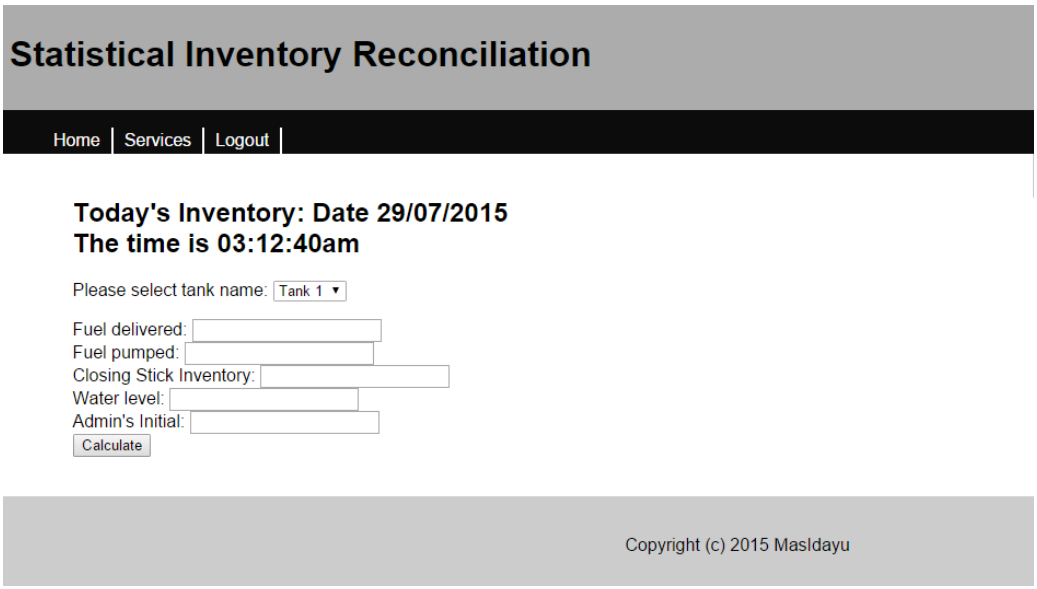


Figure 18: Services tab for SIR system

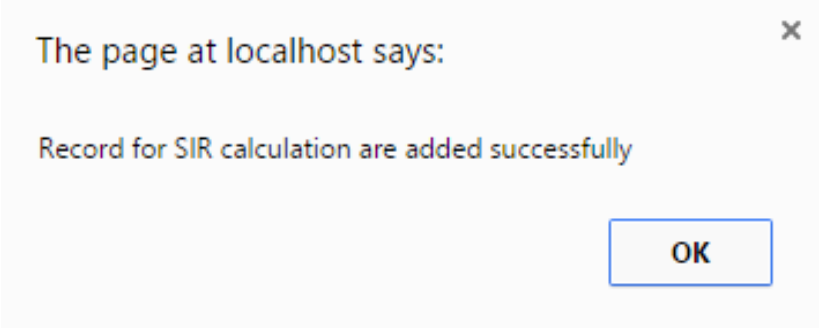


Figure 19: Message being popped-out when the daily inventory successfully inserted

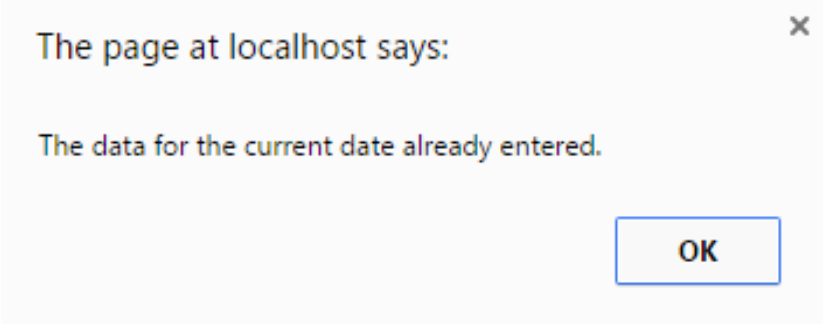


Figure 20: Message displayed if the data for current date already inserted

Report

Besides performing the calculation of leakage, the operator can also use the system to view the current and previous report that has been input and calculated. The report will be beneficial for the operator to keep track on the flow of fuel and make it easy for them to prepare the statistic of data for further action. The screenshot of Report page is as follows:

Figure 21: Report page where user has to input the month, year and tank desired

MONTHLY INVENTORY RECONCILIATION REPORT
Month/Year:07/2015
Tank:tank1

leak_id	tank_id	oil_type	sir_date	opening_inventory	fuel_delivered	fuel_pumped	inventory_bal	closing_stick_inv	daily_over_short	cum_over_short	water_inch	initial
31	tank1	RON95	2015-07-01	9676	0	541	9135	9240	105	105	0	MIMS
32	tank1	RON95	2015-07-02	9240	0	859	8381	8018	-363	-258	0	MIMS
33	tank1	RON95	2015-07-03	8018	0	980	7038	7400	362	104	0	MIMS
34	tank1	RON95	2015-07-04	7400	0	852	6548	6560	12	116	0	MIMS
35	tank1	RON95	2015-07-05	6560	0	1408	5152	4807	-345	-229	0	MIMS
36	tank1	RON95	2015-07-06	4807	7571	734	11644	12019	375	146	0	MIMS
37	tank1	RON95	2015-07-07	12019	0	556	11463	11356	-107	39	0	MIMS
38	tank1	RON95	2015-07-08	11356	0	621	10735	10762	27	66	0	MIMS
39	tank1	RON95	2015-07-09	10762	0	1537	9225	8782	-443	-377	0	MIMS
40	tank1	RON95	2015-07-10	8782	0	1367	7415	7771	356	-21	0	MIMS
41	tank1	RON95	2015-07-11	7771	0	708	7063	7041	-22	-43	0	MIMS
42	tank1	RON95	2015-07-12	7041	0	1033	6008	6087	79	36	0	MIMS
43	tank1	RON95	2015-07-13	6087	0	1851	4236	4232	-4	32	0	MIMS
44	tank1	RON95	2015-07-14	4232	0	367	3865	3785	-80	-48	0	MIMS
45	tank1	RON95	2015-07-15	3785	0	500	3285	3161	-124	-172	0	MIMS
46	tank1	RON95	2015-07-16	3161	0	670	2491	2290	-201	-373	0	MIMS
47	tank1	RON95	2015-07-17	2290	11356	583	13063	13590	527	154	0	MIMS
48	tank1	RON95	2015-07-18	13590	0	375	13215	13211	-4	150	0	MIMS
49	tank1	RON95	2015-07-19	13211	0	1105	12106	12151	45	195	0	MIMS
50	tank1	RON95	2015-07-20	12151	0	1806	10345	10262	-83	112	0	MIMS
51	tank1	RON95	2015-07-21	10262	0	95	10167	9797	-370	-258	0	MIMS
52	tank1	RON95	2015-07-22	9797	0	405	9392	8782	-610	-868	0	MIMS
53	tank1	RON95	2015-07-23	8782	0	961	7821	7893	72	-796	0	MIMS

Figure 22: Monthly report is displayed in table form

38	tank1	RON95	2015-07-08	11356	0	621	10735	10762	27	66	0	MIMS
39	tank1	RON95	2015-07-09	10762	0	1537	9225	8782	-443	-377	0	MIMS
40	tank1	RON95	2015-07-10	8782	0	1367	7415	7771	356	-21	0	MIMS
41	tank1	RON95	2015-07-11	7771	0	708	7063	7041	-22	-43	0	MIMS
42	tank1	RON95	2015-07-12	7041	0	1033	6008	6087	79	36	0	MIMS
43	tank1	RON95	2015-07-13	6087	0	1851	4236	4232	-4	32	0	MIMS
44	tank1	RON95	2015-07-14	4232	0	367	3865	3785	-80	-48	0	MIMS
45	tank1	RON95	2015-07-15	3785	0	500	3285	3161	-124	-172	0	MIMS
46	tank1	RON95	2015-07-16	3161	0	670	2491	2290	-201	-373	0	MIMS
47	tank1	RON95	2015-07-17	2290	11356	583	13063	13590	527	154	0	MIMS
48	tank1	RON95	2015-07-18	13590	0	375	13215	13211	-4	150	0	MIMS
49	tank1	RON95	2015-07-19	13211	0	1105	12106	12151	45	195	0	MIMS
50	tank1	RON95	2015-07-20	12151	0	1806	10345	10262	-83	112	0	MIMS
51	tank1	RON95	2015-07-21	10262	0	95	10167	9797	-370	-258	0	MIMS
52	tank1	RON95	2015-07-22	9797	0	405	9392	8782	-610	-868	0	MIMS
53	tank1	RON95	2015-07-23	8782	0	961	7821	7893	72	-796	0	MIMS
54	tank1	RON95	2015-07-24	7893	0	1147	6746	14578	7832	7036	0	MIMS
55	tank1	RON95	2015-07-25	14578	7571	727	21422	13416	-8006	-970	0	MIMS
56	tank1	RON95	2015-07-26	13416	0	1075	12341	11640	-701	-1671	0	MIMS
57	tank1	RON95	2015-07-27	11640	0	1855	9785	10970	1185	-486	0	MIMS
58	tank1	RON95	2015-07-28	10970	0	628	10342	8795	-1547	-2033	0	MIMS
59	tank1	RON95	2015-07-29	8795	0	705	8090	4959	-3131	-5164	0	MIMS
60	tank1	RON95	2015-07-30	4959	0	119	4840	10590	5750	586	0	MIMS
66	tank1	RON95	2015-07-31	10590	0	444	10146	8888	-1258	-672	0	MIMS

sir_date	tank_id	first_inventory	sum_delivered	sum_pumped	math_check	last_inventory	final_cumulative	leak_check	leak_result
2015-07-31	tank1	9676	26498	26170	10004	8888	1116	262	LEAK

Figure 23: Result of leakage also being displayed

4.2.2 Database Architecture

In order to keep the inventory data available after the user input, the data of daily information and monthly result is stored in a database. For this application, PhpMyAdmin with MySQL as the server type is used to handle all the data handling storage. PhpMyAdmin is chosen because the language used to develop the project is PHP so it is easier to write the SQL in PHP than in other languages. Besides, the application comes together in the XAMPP application used and is more user-friendly.

There will be three tables in the database which comprise of the following:

1. **User's Account Information (user_account) : store details of users of the system**
2. **SIR Calculation (sir_calculation) : store daily data inventory**
3. **SIR Result (sir_result) : store result of SIR calculation for the month**

Figures below shows each table as per mentioned above in PhpMyAdmin:

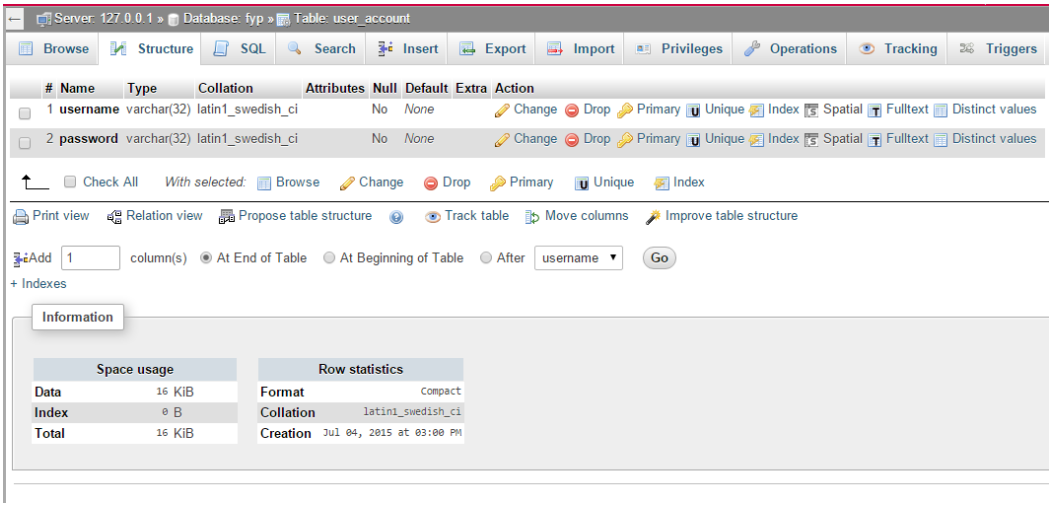


Figure 24: user_account table

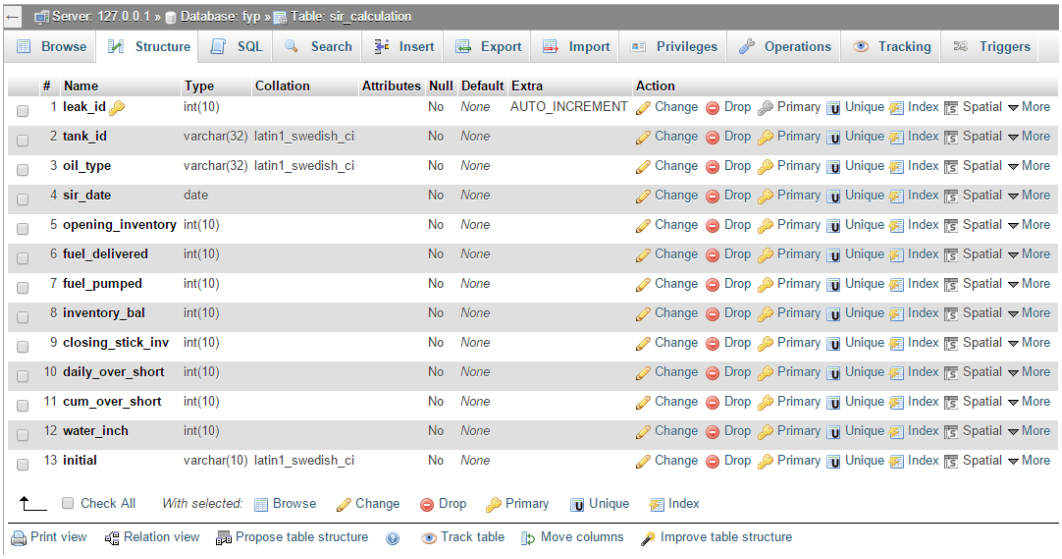


Figure 25: sir_calculation table

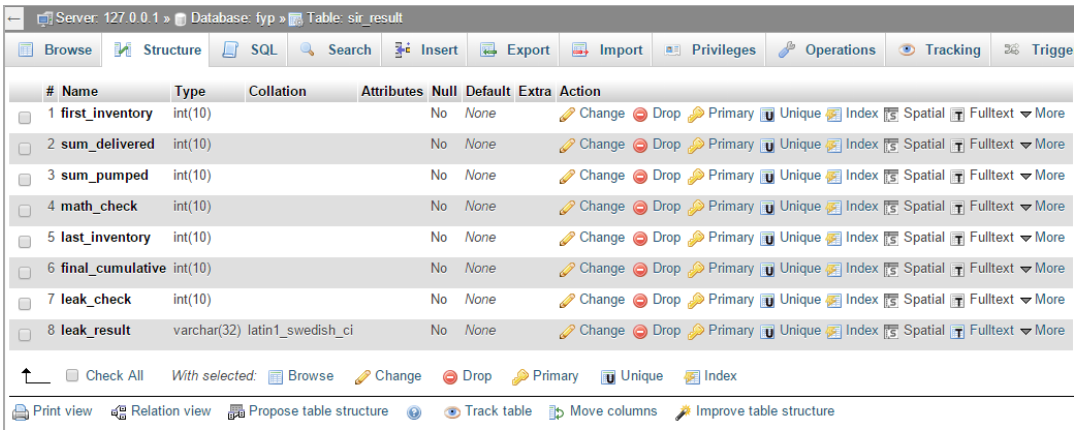


Figure 26: sir_result table

4.3 Post Survey and Testing

The testing process is the crucial parts in the implementation part of the system. Realizing the importance of testing, user testing has been done throughout the development period to ensure that the system built is match with the design being created earlier. Besides performing user testing, the prototype has also being showed to two internal examiners and is tested during the Pre-SEDEX. From the testing, the system being developed could perform the functionalities being assigned to them successfully. But the system still needs to be altered to ensure that the list of daily inventory report being calculated can be displayed and the “Inventory” tab should be added to the system.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

In enhancing the effectiveness and efficiency of petrol station retails risk assessment and crisis management, the role of ICT in the petroleum industry is seen as one of the important parts in order for the petrol station retails to compete with the local and global market. Ensuring safety of the employees and surrounding people is one of the important roles that need to be taken into account of a manager of petrol station. Previous studies have already proven that the usage of SIR for leak detection in UST for petrol station will eventually help in reducing the number of risk occurring in petrol station.

It is indeed true that the occurrences of hazards in petrol stations could not be stopped but by assessing the risks and preventing it from happen, the number of accidents in petrol stations can be reduced in the future. At the beginning of the paper, it has been emphasized that the effects from hazards of petrol station retails will give huge impact to the surrounding environment and people nearby. Air and soil pollution might as well happen and this will contribute to unhealthy environment.

There are indeed some limitations in the system which can be a subject for future research. The system would be more intelligent if it can be done in mobile. It will be easier for the operator to walk through each tank and record data immediately. For future recommendation, the system might as well be built in mobile platform and the result can be alerted immediately to the petrol station manager should he/she is not available at the station.

It is also encouraged that more studies in risk assessment for petrol station in Malaysia to be done in the future. The developed countries as mentioned by Ahmed et. al (2012) are more advanced in maintaining the records and statistics of risk assessments rather than the developing countries including Malaysia. The society of the countries are all responsible in educating and implementing the best HSE acts to ensure that the country is free from environmental pollution and hazards due to inappropriate HSE conduct in petrol station retails.

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APPENDICES

APPENDIX 1

Questionnaires for "Fuel Station Retailer Management System"

Interviewee : Mr. Amran bin Ahmad, Manager of PETRONAS petrol station retail in Kedah

Year : 2015

1. What is the current system being used to manage the fuel station retailer? (eg: Point on Sale (POS) software)

   Currently, we are using Point on Sale (POS) software.

2. Does the system covers more than just transaction system management which is used by the cashier at the counter?

   No.

3. If yes, does the system integrated with any of these functionalities? (Please tick on functionalities that are currently available)

   - ✓ Calculate total daily sales
   - ✓ Compare today's sales and yesterday's sales
   - ✓ Generate weekly, monthly and yearly graph sales performances
   - ✓ Generate weekly, monthly and yearly statistics of sales
   - ✓ Provide daily routine report (eg: most product being bought for today)
   - ✓ Keep track on total amount of stock for fuel (RON95, RON97 & DIESEL)
   - ✓ Keep track on total amount of stock for other products being sold in mart

- ✓ Forecast on next consumption day of oil based on current stock available
- ✓ Generate trend of customers' purchase (eg: Customer who buy RON97 fuel will most likely purchase oil for full tank; More customers during festive season; etc)
- ✓ Keep track on employees' attendance and performance
- ✓ Risk assessment (HSE management system)
- □ Generate daily, weekly, monthly and yearly sales report

4. How does the fuel price being changed using the current system?

   Not sure

5. How frequent does the fuel consumption being done? (eg: 100 barrels per three days) Not sure

6. Does the retailer still use any manual way of calculating or recording for sales report? (eg: record in logbook)

   No

7. Can the current system be remotely accessed by the manager of the retail from anywhere (eg: From home, overseas, etc.)

   No

8. Is there any kind of business or IT model being used for management of fuel station retailer currently? Please state if any.

   No

9. Is there any issue or defect being detected with the current problem? (eg: not used friendly; less security; etc.)

   No

10. If the manager and supervisor are not available at the retailer, how they actually manage the retailer currently?

    By the co-supervisor otherwise, when the staff have something to do wish the cash money they need to call the supervisor to ask permission.

11. Is there any system or model that cover the risk assessment that might happen at the petrol station (eg: risk of accident)

    Yes, HSE is the most priority issues to the petrol stations. but not so sure what is the system or model.

12. Do you think it is important for a petrol station to have a good system to manage the risk assessment? Why?

    Yes, because petrol station deal with the fuel, and the customer and people around deal with risks.

13. If a computerized risk assessment management system being built, do you think it will help petrol station manager in reducing risks in petrol station?

    Yes

APPENDIX 2: GANTT CHART

FYP 1 PROJECT GANTT CHART

TASK	WEEK													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
• Define objective, problem statement and short summary on the project title			◆											
• Define project scope					◆									
• Narrow down project scope														
• Find previous research papers for literature review														
• Conduct interview/questionnaires and prepare interview report										◆				
• Designing the business model for the system											◆			
• Sketching the architectural diagram for the system														

◆ : Project Milestone

FYP 2 PROJECT GANTT CHART

TASKS	WEEK													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
• Designing the system architecture														
• Designing the GUI of the system to be built														
• Setting up the workspace to build the system														
• Build databases														
• Coding and development														
• System implementation														
• Perform testing														

APPENDIX 3: CODING

final.html

```
<!doctype html>
<html>
<head>
<title>Statistical Inventory Reconciliation System</title>
<link rel="stylesheet" type="text/css" href="final.css">
</head>
<body>
<div id="container">
      <div id="header">
            <h1>Statistical Inventory Reconciliation</h1>
      </div> <!-- end header -->
            <div id="menu">
                  <ul>
                        <li><a href="final.html">Home</a></li>
                        <!--<li><a
href="service.php">Services</a></li>-->
                        <li><a href='login.php'>Login</a></li>
                  </ul>
            </div> <!-- end menu -->
            <div id="mainContainer">
                  <div id="content">
                        <p><img src="check.gif" alt="Check"
style="width:300px;height:150px;"></p>
                        <h2>Tank information</h2>
                        <p><img src="Tank.png" alt="Tank"
style="width:500px;height:300px;"></p>
                  </div> <!-- end content -->
                  <div id="sidebar">
                        <h3>Tank information</h3>
                              <ul>
                                    <li>Tank 1</li>
                                    <li>Tank 2</li>
                                    <li>Tank 3</li>
                                    <li>Tank 4</li>
                              </ul>
                  </div> <!-- end sidebar -->
                  <div id="footer">
                        <p>Copyright (c) 2015 MasIdayu</p>
                  </div> <!-- end footer -->
            </div> <!-- end mainContainer -->
</div> <!-- end container -->
<script type="text/javascript">
      alert("Please login to continue");
</script>
</body>
</html>
```

---

database.php

```
<?php
mysql_connect("localhost","fypmas","mas123") or die(mysql_error());
mysql_select_db("fyp");
?>
```

---

login.php

```
<?php
                  include 'database.php'; //connect the connection
page
                  if(empty($_SESSION)) // if the session not yet
started
                     session_start();


                  if(isset($_SESSION['username'])) { // if already
login
                    header("location: home.php"); // send to home
page
                    exit;
                  }

                  ?>
<html>
<head>
<title>Statistical Inventory Reconciliation System: Login</title>
<link rel="stylesheet" type="text/css" href="final.css">
</head>
<body>
<body>
<div id="container">
      <div id="header">
            <h1>Statistical Inventory Reconciliation</h1>
      </div> <!-- end header -->
            <div id="menu">
                  <ul>
                        <li><a href="home.php">Home</a></li>
                        <!--<li><a
href="service.php">Services</a></li>-->
                        <li><a href='login.php'>Login</a></li>
                  </ul>
            </div> <!-- end menu -->
            <div id="mainContainer">
                  <div id="content">
                        <form action = "login_process.php" method =
"post">
                              Username: <input type="text"
name="username" /><br />
                              Password: <input type="password"
name="password" /><br />
                              <input type = "submit" name="submit"
value="login" />
                              </form>
                  </div> <!-- end content -->
                  <div id="sidebar">
                        <h3>Menu</h3>
                              <ul>
                                    <li>Menu item 1</li>
                                    <li>Menu item 2</li>
                                    <li>Menu item 3</li>
                              </ul>
                  </div> <!-- end sidebar -->
                  <div id="footer">
                        <p>Copyright (c) 2015 MasIdayu</p>
```

```
                </div> <!-- end footer -->
            </div> <!-- end mainContainer -->
</div> <!-- end container -->
</body>
</html>
```

---

login process.php

```
<?php
include 'database.php'; //connect the connection page

if(empty($_SESSION)) // if the session not yet started
   session_start();
if(!isset($_POST['submit'])) { // if the form not yet submitted
   header("Location: login.php");
   exit;
}
//check if the username entered is in the database.
$test_query = "SELECT * FROM user_account WHERE username =
'".$_POST[username]."'";
$query_result = mysql_query($test_query);
//conditions
if(mysql_num_rows($query_result)==0) {
//if username entered not yet exists
      echo "<script type='text/javascript'>alert('The username you
entered is invalid.')</script>";
   // echo "The username you entered is invalid.";
}else {
//if exists, then extract the password.
    while($row_query = mysql_fetch_array($query_result)) {
        // check if password are equal
        if($row_query['password']==$_POST['password']){
            $_SESSION['password'] = $_POST['password'];
            header("Location: home.php");
            exit;
        } else{ // if not
            echo "<script type='text/javascript'>alert('Invalid
password.')</script>";
        }
    }
}
?>
```

---

home.php

```
<!doctype html>
<html>
<head>
<title>Statistical Inventory Reconciliation System</title>
<link rel="stylesheet" type="text/css" href="final.css">
</head>
<body>
<div id="container">
      <div id="header">
            <h1>Statistical Inventory Reconciliation</h1>
```

```
      </div> <!-- end header -->
            <div id="menu">
                  <ul>
                        <li><a href="home.php">Home</a></li>
                        <li><a href="service.php">Services</a></li>
                        <li><a href='logout.php'>Logout</a></li>
                  </ul>
            </div> <!-- end menu -->
            <div id="mainContainer">
                  <div id="content">
                        <h2>Do you meet all your monthly leak
detection requirements?</h2>
                        <p>SIR Program is a cost effective leak
detection service for
                              your UST system. Leak detection
standards were implemented and
                              must be performed in a manner that
would alert the operator to a
                              suspected release from any part of the
tank system (tanks and lines),
                              allowing a timely response to stop the
release.</p>
                  </div> <!-- end content -->
                  <div id="sidebar">
                        <h3>Last check was on:
                        <?php
                        $d=strtotime("yesterday");
                        $yesterday_date = date("Y-m-d", $d);
                        echo "Date " . $yesterday_date . "<br>";
                        ?>
                        <p><img src="station.gif" alt="Station"
style="width:400px;height:150px;"></p>
                  </div> <!-- end sidebar -->
                  <div id="footer">
                        <p>Copyright (c) 2015 MasIdayu</p>
                  </div> <!-- end footer -->
            </div> <!-- end mainContainer -->
</div> <!-- end container -->
<script type="text/javascript">
      alert("Welcome to SIR page!");
</script>
</body>
</html>
```

---

service.php

```
<?php
                  include 'database.php'; //connect the connection
page
                  if(empty($_SESSION)) // if the session not yet
started
                     session_start();
?>

<html>
<head>
<title>Statistical Inventory Reconciliation System: SIR Form</title>
<link rel="stylesheet" type="text/css" href="final.css">
```

```
</head>
<body>
<body>
<div id="container">
      <div id="header">
            <h1>Statistical Inventory Reconciliation</h1>
      </div> <!-- end header -->
            <div id="menu">
                  <ul>
                        <li><a href="home.php">Home</a></li>
                        <li><a href="service.php">Services</a></li>
                        <li><a href='logout.php'>Logout</a></li>
                  </ul>
            </div> <!-- end menu -->
            <div id="mainContainer">
                  <div id="content">
                        <h2>Today's Inventory: <?php echo "Date " .
date("d/m/Y") . "<br>";
                                                                  echo
"The time is " . date("h:i:sa");
                                                                  ?>
                        </h2>
                        <form action = "form_process.php" method =
"post">
                        <p>Please select tank name:
                              <select name="tank">
                                <option value="tank1">Tank
1</option>
                                <option value="tank2">Tank
2</option>
                                <option value="tank3">Tank
3</option>
                              </select>
                        </p>
                              Fuel delivered: <input type="text"
name="fuel_delivered" /><br />
                              Fuel pumped: <input type="text"
name="fuel_pumped" /><br />
                              Closing Stick Inventory: <input
type="text" name="closing_stick_inv" /><br />
                              Water level: <input type="text"
name="water_inch" /><br />
                              Admin's Initial: <input type="text"
name="initial" /><br />
                              <input type = "submit" name="submit"
value="Calculate" />
                              </form>
                  </div> <!-- end content -->
                  <div id="sidebar">
                        <!---<h3>Menu</h3>
                              <ul>
                                    <li>Menu item 1</li>
                                    <li>Menu item 2</li>
                                    <li>Menu item 3</li>
                              </ul>--->
                  </div> <!-- end sidebar -->
                  <div id="footer">
                        <p>Copyright (c) 2015 MasIdayu</p>
                  </div> <!-- end footer -->
            </div> <!-- end mainContainer -->
</div> <!-- end container -->
```

```
</body>
</html>
```

---

form process.php

```
<?php
include 'database.php'; //connect the connection page

if(empty($_SESSION)) // if the session not yet started
   session_start();
if(!isset($_POST['submit'])) { // if the form not yet submitted
   header("Location: service.php");
   exit;
}

$tank_id = ($_POST['tank']);
$fuel_delivered = ($_POST['fuel_delivered']);
$fuel_pumped = ($_POST['fuel_pumped']);
$closing_stick_inv = ($_POST['closing_stick_inv']);
$water_inch = ($_POST['water_inch']);
$initial = ($_POST['initial']);
$today_date = date("Y-m-d");

//set the oil type based on tank id
if($tank_id == "tank1")
{
      $oil_type = "RON95";

}else if($tank_id == "tank2")
{
      $oil_type = "RON97";

}else{
      $oil_type = "DIESEL";
}

//query for data on current date
$date_query = "SELECT * FROM sir_calculation WHERE sir_date =
'$today_date'";
$date_result = mysql_query($date_query);

//check for previous closing inventory
$d=strtotime("yesterday");
$yesterday_date = date("Y-m-d", $d);

$prev_inventory_query = "SELECT * FROM sir_calculation WHERE
sir_date = '$yesterday_date'";
$prev_inventory_result = mysql_query($prev_inventory_query);
if(mysql_num_rows($prev_inventory_result)==0) {
            //if yesterday date not exist
            $opening_inventory = 9676; //set a dummy data

}else {

         //if date exist, take the amount of closing stick inventory
from yesterday's date
         $opening_inventory = "SELECT closing_stick_inv from
sir_calculation where sir_date = '$yesterday_date'";
```

```
}

//calculate inventory balance
$inventory_bal = $opening_inventory + $fuel_delivered -
$fuel_pumped;

//calculate daily over/short
$daily_over_short = $closing_stick_inv - $inventory_bal;

//calculate cumulative over/short
if(date("Y-m-d") == date("Y-m-01")){
      $cum_over_short = $daily_over_short;
} else{
      $cum_over_short = "SELECT cum_over_short from sir_calculation
where sir_date = '$yesterday_date'" + $daily_over_short;
}


//perform leak check for the month
$last_day = "SELECT LAST_DAY($today_date)";



//insert data into sir_calculation database
if(mysql_num_rows($date_result)==0) {
            //if current date not yet exist
            $sql = "INSERT INTO sir_calculation (tank_id, oil_type,
sir_date, opening_inventory, fuel_delivered, fuel_pumped,
inventory_bal, closing_stick_inv,
                        daily_over_short, cum_over_short,
water_inch, initial)
            VALUES ('$tank_id', '$oil_type', '$today_date',
'$opening_inventory', '$fuel_delivered', '$fuel_pumped',
'$inventory_bal', '$closing_stick_inv',
                        '$daily_over_short', '$cum_over_short',
'$water_inch', '$initial')";

            if($last_day == $today_date){
                  //check for first opening_inventory of the month
                  $firstday_date = date("Y-m-01");
                  $first_inventory = "SELECT opening_inventory from
sir_calculation where sir_date = '$firstday_date'";

                  //get value of sum of fuel delivered for the month
                  $sum_delivered = "SELECT SUM(fuel_delivered) FROM
sir_calculation WHERE MONTH(sir_date) = MONTH(CURRENT_DATE) AND
YEAR(sir_date) = YEAR(CURRENT_DATE)";

                  //get value of sum of fuel pumped for the month
                  $sum_pumped = "SELECT SUM(fuel_pumped) FROM
sir_calculation WHERE MONTH(sir_date) = MONTH(CURRENT_DATE) AND
YEAR(sir_date) = YEAR(CURRENT_DATE)";

                  //calculate the math check
                  $math_check = $first_inventory + $sum_delivered -
$sum_pumped;

                  //get the last closing stick inventory
                  $last_inventory = $closing_stick_inv;
```

```
                  //calculate the final cumulative
                  $final_cumulative = $last_inventory - $math_check;

                  //calculate leak check result
                  $leak_check = $sum_pumped * 0.01;

                  //compare leak check result and cumulative
over/short
                  if($final_cumulative < 0){
                        $final_cumulative = $final_cumulative * (-
1);
                  }

                  if($final_cumulative > $leak_check){
                        $leak_result = "LEAK";
                        echo "Leakage detected. Please notify main
department within 24 hours.";
                  }else{
                        $leak_result = "PASS";
                        echo "Tank passes leak detection test for
this month.";
                  }

                  //insert data into sir_result to calculate leak
result
                  $sql_result = "INSERT INTO sir_result
(first_inventory, sum_delivered, sum_pumped, math_check,
last_inventory, final_cumulative,
                                          leak_check, leak_result)
                  VALUES ('$first_inventory', '$sum_delivered',
'$sum_pumped', '$math_check', '$last_inventory',
'$final_cumulative',
                                       '$leak_check', '$leak_result')";

                  if(mysql_query($sql_result)){
                        echo "Records for sir_result are added
successfully.";
                  } else{
                        echo "ERROR: Could not able to execute $sql.
" . mysql_error();
                  }
            }

            if(mysql_query($sql)){
            echo '<script type="text/javascript">';
            echo 'alert("Record for SIR calculation are added
successfully");';
            echo 'window.location.href = "home.php";';
            echo '</script>';
            } else{
                  //echo "<script
type='text/javascript'>alert('ERROR! Could not able to execute
$sql.')</script>" . mysql_error();
                  echo '<script type="text/javascript">';
                  echo 'alert("ERROR! Could not able to execute
$sql.");';
                  echo 'window.location.href = "home.php";';
                  echo '</script>' . mysql_error();
            }

}else {
```

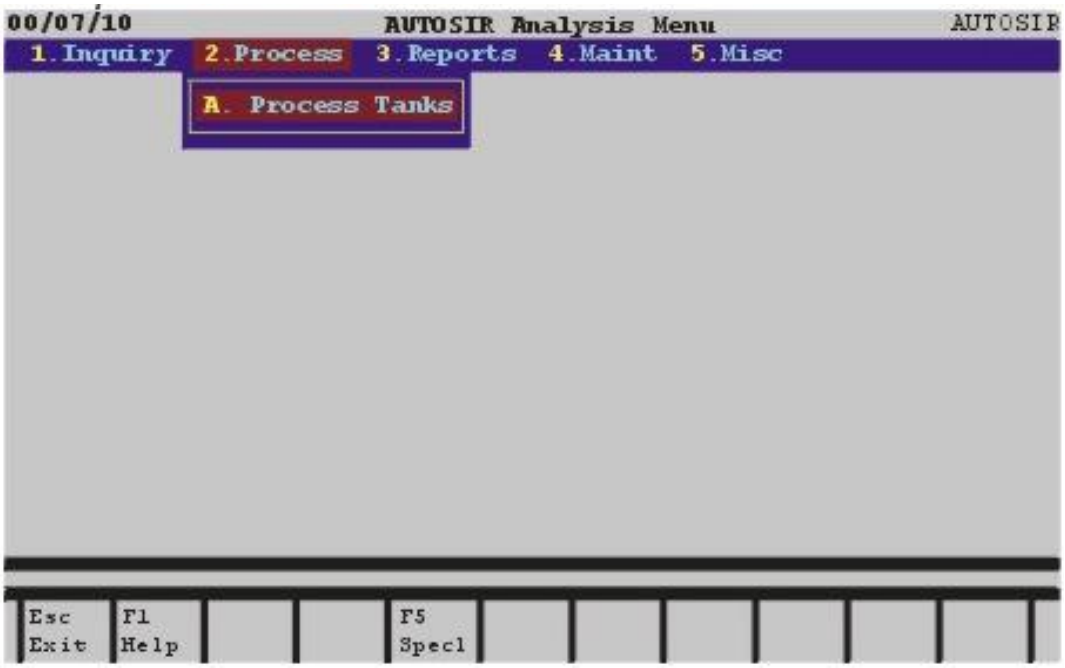
```
         //if date exist, don't input data
          echo '<script type="text/javascript">';
            echo 'alert("The data for the current date already
entered.");';
            echo 'window.location.href = "home.php";';
            echo '</script>';
}



?>
```

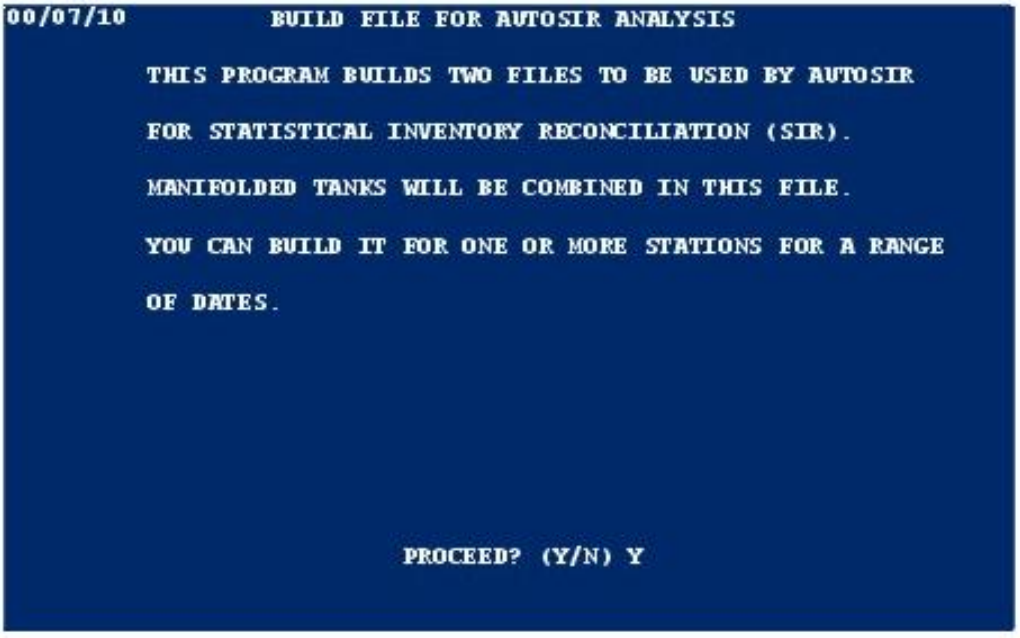
---

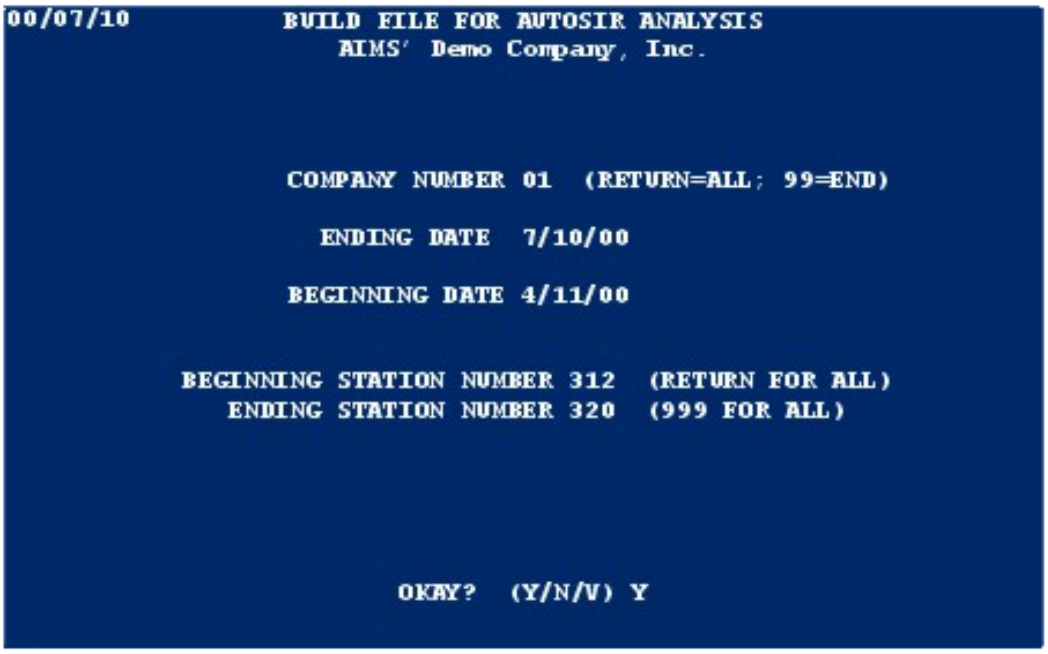
logout.php

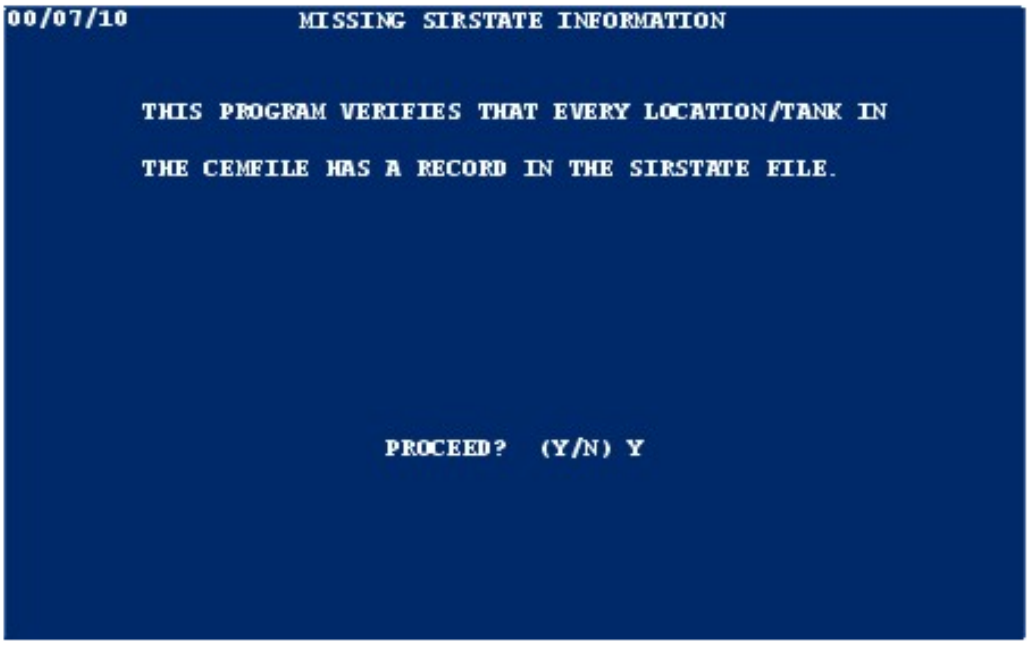
```
<?php
session_start();
unset($_SESSION['username']);
session_destroy();

header("Location: final.html");
exit;
?>
```

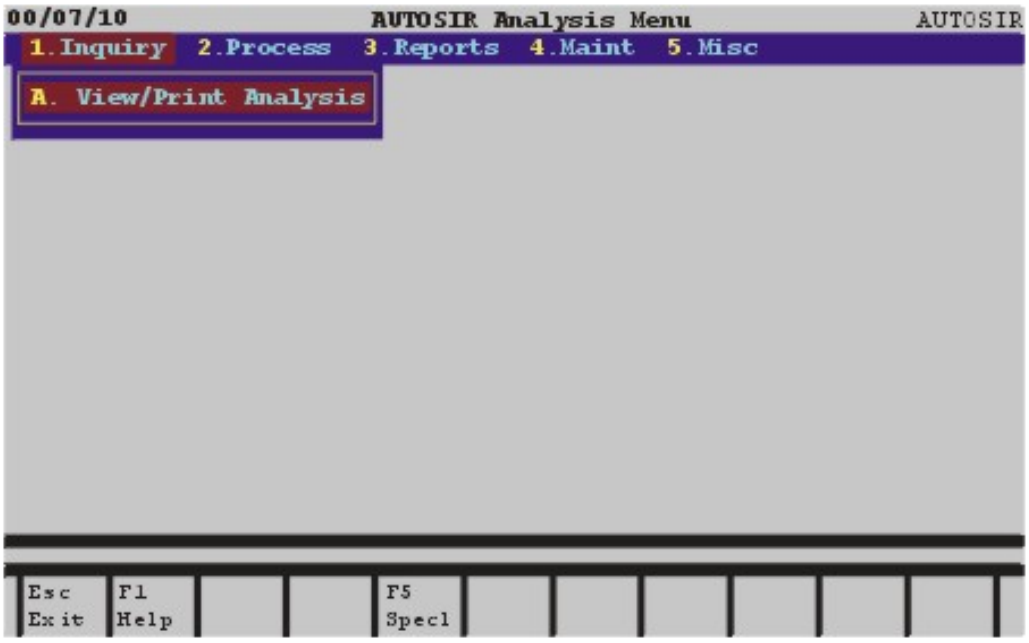
APPENDIX 4: GRAPHICAL USER INTERFACE OF EXISTING SYSTEM (AUTOSIR)

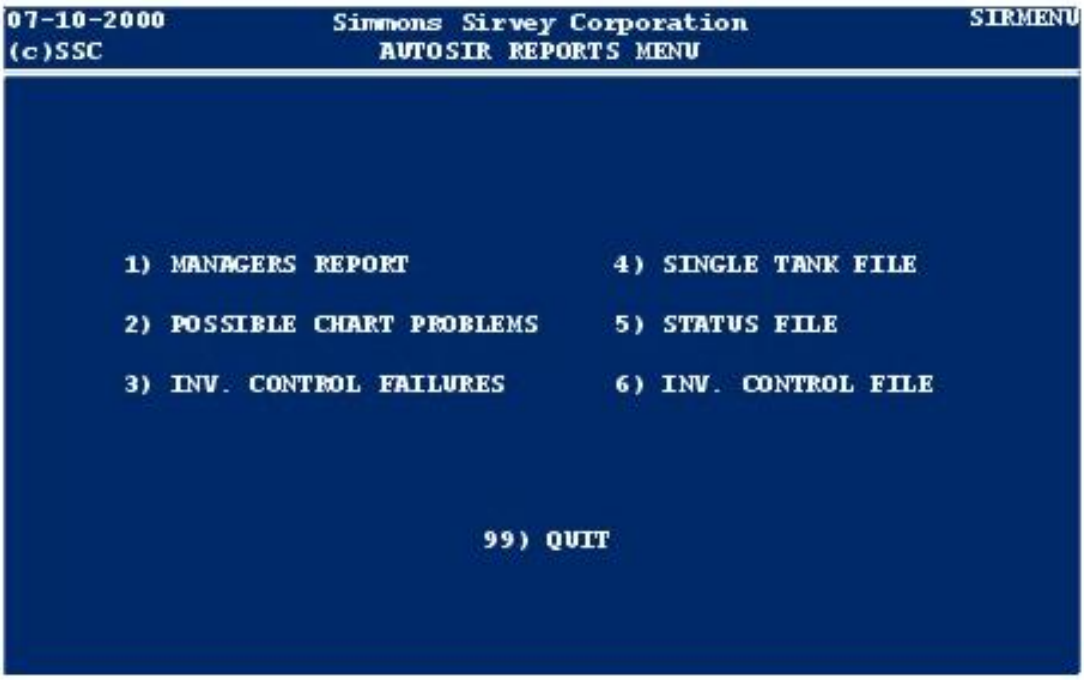





00/07/10
BUILD FILE FOR AUTOSIR ANALYSIS
AIMS' Demo Company, Inc.
COMPANY NUMBER 01 (RETURN=ALL; 99=END)
ENDING DATE 7/10/00
BEGINNING DATE 4/11/00
BEGINNING STATION NUMBER 312 (RETURN FOR ALL)
ENDING STATION NUMBER 320 (999 FOR ALL)
OKAY? (Y/N/V) Y


00/07/10
MISSING SIRSTATE INFORMATION
THIS PROGRAM VERIFIES THAT EVERY LOCATION/TANK IN
THE CEMFILE HAS A RECORD IN THE SIRSTATE FILE.
PROCEED? (Y/N) Y


00/07/10
AUTOSIR Analysis Menu
AUTOSIR
1.Inquiry 2.Process 3.Reports 4.Maint 5.Misc
A. View/Print Analysis
Esc Exit
F1 Help
F5 Specl



AIMS DEMO COMPANY
AUTOSIR

CURRENT TANK STATUS' 07-10-2000 14:45:43

CO.	LOC.	TK	STATUS	PERIOD
01	312	01	**LOSING TREND DETECTED**	04/11/00-07/10/00
01	312	02	NO REPORTABLE LOSS DETECTED	04/11/00-07/10/00
01	312	03	NO REPORTABLE LOSS DETECTED	04/11/00-07/10/00
01	312	04	NO REPORTABLE LOSS DETECTED	04/11/00-07/10/00
01	315	01	NO REPORTABLE LOSS DETECTED	04/11/00-07/10/00
01	315	02	NO REPORTABLE LOSS DETECTED	04/11/00-07/10/00
01	315	03	NO REPORTABLE LOSS DETECTED	04/11/00-07/10/00
01	315	04	NO REPORTABLE LOSS DETECTED	04/11/00-07/10/00
01	320	01	NO REPORTABLE LOSS DETECTED	04/11/00-07/10/00
01	320	02	NO REPORTABLE LOSS DETECTED	04/11/00-07/10/00
01	320	03	NO REPORTABLE LOSS DETECTED	04/11/00-07/10/00
01	320	04	NO REPORTABLE LOSS DETECTED	04/11/00-07/10/00
01	600	01	NOT ENOUGH DATA POINTS FOR AN ANALYSIS	06/22/00-07/10/00
01	600	02	NOT ENOUGH DATA POINTS FOR AN ANALYSIS	06/22/00-07/10/00
01	600	03	NOT ENOUGH DATA POINTS FOR AN ANALYSIS	06/22/00-07/10/00
01	600	04	NOT ENOUGH DATA POINTS FOR AN ANALYSIS	06/22/00-07/10/00